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Officer Career Development: An Overview of Analytic Concerns

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Officer Career Development: An Overview of Analytic Concerns

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A review is provided of the data bank developed by the Personnel Distribution and Career Development (PDCD) work unit for the purpose of establishing empirically-based decision guides to assist in the design and implementation of career policy and practice in the U.S. Navy. Salient methodological issues and problems likely to be encountered in analyses of data from the data bank are also considered.

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FOREWORD

This report focuses on a review of the data bank developed with the Personnel Distribution and Career Development (PDCD) work unit prior to establishing guidelines to apply in the analysis of the data. This initial report reflects general concerns pertaining to analytical strategies and establishes the parameters for identifying assumptions and specifying the analytical strategies that will be detailed in the second report.

This is the first of two reports completed with TCN 87-621; the contracting officer's technical representative for the work was Robert F. Morrison. TCN 87-621 was conducted within exploratory development (Program Element 0602233N) under work unit 1488WX4B529, PDCD, sponsored by the Chief of Naval Research (ONR-222). This report is the 14th published within PDCD and is intended for use in the PDCD work unit.

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Director, Personnel Systems Department

Prior PDCD Publications

1. Cook, T. M., & Morrison, R. G. (1982, August). Surface warfare junior officer retention: Early career development factors (NPRDC TR 82-59). San Diego: Navy Personnel Research and Development Center.

2. Cook, T. M., & Morrison, R. F. (1983, January). Surface warfare junior officers retention: Background and first sea tour factors as predictors of continuance beyond obligated service (NPRDC TR 83-6). San Diego: Navy Personnel Research and Development Center.

3. Morrison, R. F. (1983, July). Officer career development: Surface warfare officer interviews (NPRDC TN 83-11). San Diego: Navy Personnel Research and Development Center.

4. Morrison, R. F., Martinez, C., & Townsend, F. W. (1984, March). Officer career development: Description of aviation assignment decisions in the antisubmarine warfare (ASW) patrol community (NPRDC TR 84-31). San Diego: Navy Personnel Research and Development Center.

5. University of San Diego (1984, October 23-25). Proceedings: Volume I. Group reports. Tri-service career research workshop. San Diego: Continuing Education, University of San Diego. (Author)

6. Morrison, R. F., & Cook, T. M. (1985, February). Military officer career development and decision making: A multiple-cohort longitudinal analysis of the first 24 years (NPRDC MPL TN 85-4). San Diego: Navy Personnel Research and Development Center, Manpower and Personnel Laboratory.

7. Wilcove, G. L., Bruni, J. R., & Morrison, R. F. (1987, August). Officer career development: Reactions of two unrestricted line communities to detailers (NPRDC TN 87-40). San Diego: Navy Personnel Research and Development Center.

8. Morrison, R. F. (1988, March). Officer career development: URL officers in joint-duty assignments (NPRDC TN 88-26). San Diego: Navy Personnel Research and Development Center.

9. Wilcove, G. L. (Ed.) (1988, August). Officer career development: Problems of three unrestricted line communities (NPRDC TR 88-26). San Diego: Navy Personnel Research and Development Center.

10. Wilcove, G. L. (1988, September). Officer career development: general unrestricted line officer perceptions of the dual-career track (NPRDC TN 88-62). San Diego: Navy Personnel Research and Development Center.

11. Bruni, J. R., & Wilcove, G. W. (1988, October). Officer career development: Preliminary surface warfare officer perceptions of a major career path change (NPRDC TN 89-5). San Diego: Navy Personnel Research and Development Center.

12. Bruce, R. (In review). Officer career development: Fleet perceptions of the aviation duty officer program. San Diego: Navy Personnel Research and Development Center.

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SUMMARY

Problem

A large data bank has been developed by the Personnel Distribution and Career Development (PDCD) work unit for the purpose of establishing empirically-based decision guides to assist in the design and implementation of career policy and practice in the U.S. Navy. Data banks of this magnitude often engender special methodological problems during analysis.

Purpose

To identify salient methodological issues and problems likely to be encountered in tests of hypothesized career models using large banks of data obtained on U.S. Navy personnel.

Approach

Samples and domains of measurement instruments used by the PDCD work unit in the career development research are reviewed. Attention then proceeds to reviews of career models and the procedures that will be employed to test the hypothesized career models. Using these reviews as a frame of reference, important methodological issues and problems are identified and discussed. These issues/problems include the use of confirmatory analytic methods to analyze the data, procedures for testing for moderators, and methods for increasing reliability of composites of items.

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INTRODUCTION

In this first of two reports, attention is focused initially on a review of the data bank developed by the Personnel Distribution and Career Development (PDCD) work unit for the purpose of establishing empirically-based decision guides to assist in the design and implementation of career policy and practice in the U.S. Navy. Samples and domains of measurement instruments are reviewed. Attention proceeds to hypothesized career models and the procedures that will be used to test the hypothesized career model. Salient methodological issues and problems likely to be encountered in the tests of the model are considered. It is noteworthy, however, that this is an initial report that reflects only general and basic concerns pertaining to analytic strategies. The second report will be devoted specifically to delineating an analytic strategy and hence will possess greater specificity and breadth in regard to recommended analyses.

SAMPLES AND INSTRUMENTS

Samples

Two waves of questionnaire data were collected on samples of Navy officers. The first wave was collected in 1982 and is referred to as the "1982 wave." As described in Morrison and Cook (1985), the 1982 wave involved three occupational groups or "communities." The communities are (1) Surface Warfare Officers (SWO), (2) General Unrestricted Line (URL(G)), which is primarily female (80%) and includes occupational specialities such as management of shore installations, and (3) Air Warfare Officers (AWO), which encompasses the two subcommunities of pilots and Naval Flight Officers (NFO), the latter being composed of individuals with skills in electronics and navigation. Sample sizes for communities are 2,833 for SWO, 960 for URL(G), and 5,040 for AWO (Morrison & Cook, 1985, Table 1). The sampling design described in Morrison and Cook (1985) placed special emphasis on the sampling of cohorts, defined by year of commissioning. All officers commissioned in the years 1961 through 1980 were contacted to be sampled for the URL(G) community, thus providing 20 cohorts of individuals ranging in grade from Ensign to Captain. For the SWO and AWO communities, samples were drawn from officers commissioned in the years 1961 through 1976 using the same sampling plan as employed for the URL(G) community, but officers commissioned in the years 1977 through 1980 were sampled using a different plan. Nevertheless, 20 cohorts are again represented for each (sub) community, with accompanying variation in rank.

Return rates for the 1982 wave averaged approximately 40 percent over communities. Multiple reasons are apparent for this return rate, but the need to assess data for bias using variables such as demographic indicators is needed. It appears that attention has already been devoted to this issue (see Footnote 3 in Wilcove, Bruni, & Morrison, 1987).

The second wave of data, the 1986 wave, is more complex. In general terms, however, the same three communities are represented, although other communities are present in the data set. There is approximately a 65 percent overlap between individuals who completed questionnaires in the 1982 wave and in the 1986 wave (the questionnaires may vary, as explained in the next section of this report). We shall refer to the subsample of individuals who completed questionnaires in both 1982 and 1986 as the "lagged sample." The term "lagged" denotes that questionnaire data are available for each of the two waves, but it does not suggest that the scales of measurement are the same, as

implied by the term "repeated measures." Some of the lagged data do indeed involve repeated measures, either because the same or similar questionnaire was employed in both waves or because scales from different questionnaires are the same, or with scale transformations, can be made the same. Other lagged data do not take the form of repeated measures. An example is items and scales that are not common to the Aviation Officer Career Questionnaire administered in the 1982 wave and the Retirement from Navy Life Questionnaire administered in the 1986 wave.

The lagged portion of the data set extends the potential career span represented in the data to as much as 25 years. It also provides the opportunity to conduct longitudinal analyses such as cross-sectional time series with repeated measures data, longitudinal prediction with lagged data (but nonrepeated measures), and quasi-experimentation. The basic data design underlying such analyses is a cohort by years commissioned matrix with lagged data, such as provided by Figure 4 of Morrison and Cook (1985).

Nonlagged data are also represented in the 1986 wave. Included here are data from officers commissioned after the 1982 wave as well as officers commissioned in the 1961 to 1980 time span who did not complete questionnaires in the 1982 wave. The former subsample adds five cohorts to the analytic design. Members of the nonlagged 1986 wave may be employed in appropriate cross-sectional analyses of data from the 1986 wave and in tests of the reactivity of the questionnaire procedures.

There is also a set of nonlagged 1982 wave data. Technically, nonlagged in this context refers to individuals who failed to complete any form of questionnaire in the 1986 wave. These individuals may be employed in cross-sectional analyses on the 1982 data set and again to check reactivity to questionnaire procedures. They might also be employed in some forms of lagged analysis if they possess nonquestionnaire data on longitudinal criteria such as resignation or retirement.

In sum, a rather complex sampling design was implemented. Figure 1 presents a summary description of the potential samples for one community. The symbol "X_1" refers to questionnaire data collected in the 1982 wave; "X_2" refers to questionnaire data--from any questionnaire--collected in the 1986 wave. The symbol Y_1 refers to any criterion (questionnaire-based such as intent to resign/retire or nonquestionnaire-based such as outcome variables from the Officer Master File) collected in the 1982 wave, whereas Y_2 refers to any criterion collected in the 1986 wave. Lagged samples are indicated by (1) the presence of X_1Y_1 data and X_2Y_2 data, and (2) a solid line between X_1Y_1 and X_2Y_2. Nonlagged samples with 1982 wave questionnaire data (but not 1986 wave questionnaire data) are represented by X_1Y_1----Y_2; the dashed line denotes that longitudinal analyses may be conducted only for Y_2 criterion data collected by means other than a questionnaire. Nonlagged samples with only 1986 wave data have only an X_2Y_2 representation. Note that the five cohorts added in the 1986 wave questionnaire administration (Cohorts 1 through 5 at the bottom of Figure 1) have only X_2Y_2 data.

An issue addressed later in this report is whether sample size should be maximized for any particular analysis versus whether comparability in sample size should be maintained over different analyses. We also consider questions such as how cohorts may be combined and the use of cross-sectional versus longitudinal analytic designs.

Instruments

A truly massive amount of information has been collected in this project. A key source of information is provided by various forms of the Officer Career Questionnaire (OCQ), each of which contains approximately 1,000 items. Three versions of the OCQ

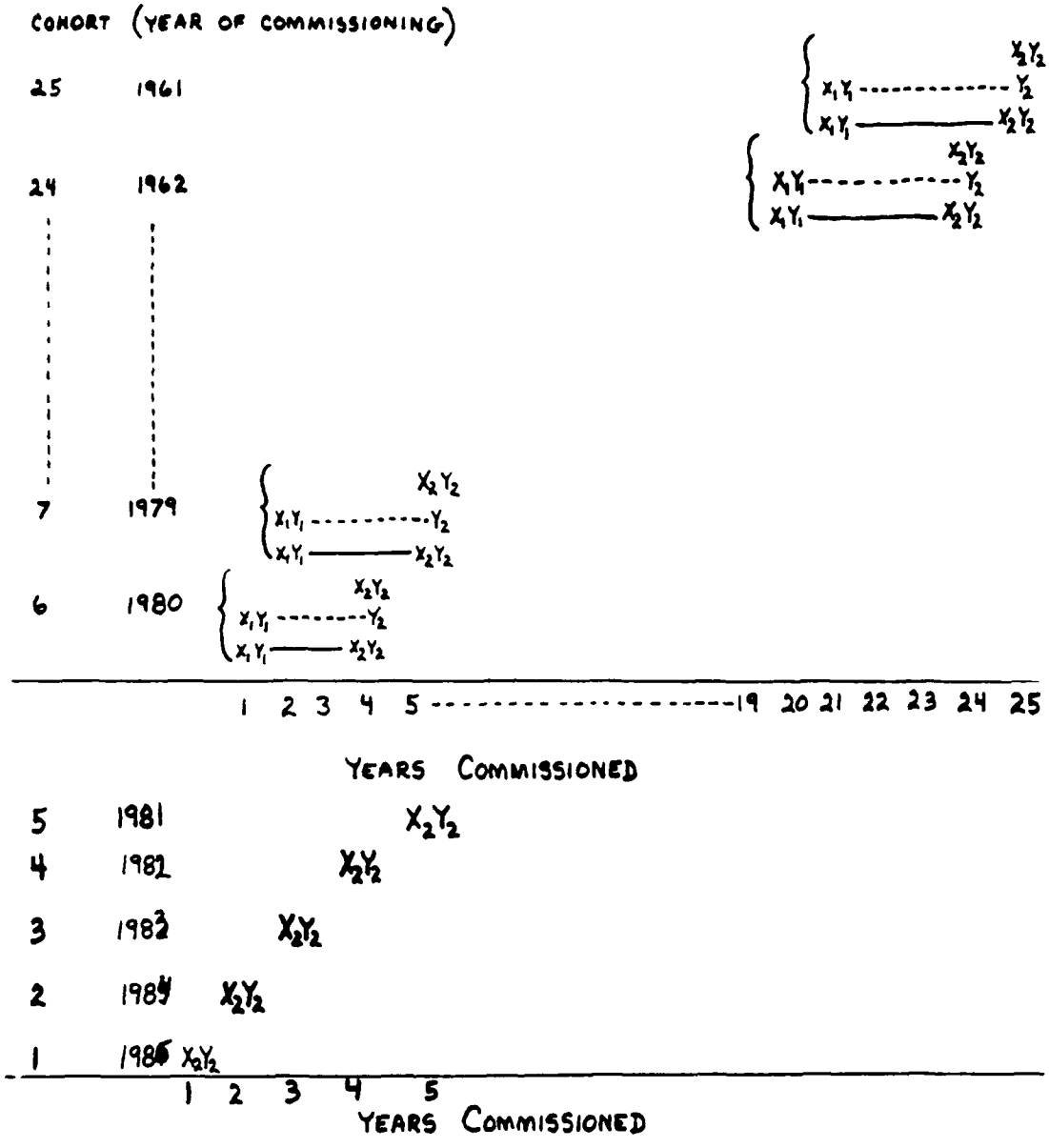


Figure 1. Multiple cohort, lagged versus nonlagged design for one community.

were administered in the 1982 wave; the different forms correspond to the three communities and reflect community-level differences in organizational policy and career paths (Morrison & Cook, 1985). However, the three forms share a common core of 688 items.

Somewhat revised forms of the three versions of the OCQ were administered in the 1986 wave. In addition, separate questionnaires were developed for individuals who had retired from the Navy (n = 700, 80% of whom have 1982 wave data), resigned from the Navy (2 questionnaires, n = 1,250), or changed designators (e.g., changed from unrestricted

line to restricted line, or changed from one unrestricted line community to another unrestricted line community).

A second basic source of data is the Officer Master File (cf. Morrison, Martinez, & Townsend, 1984). This file contains historical data on Navy officers such as year of commissioning, commissioning source, educational background, promotion dates, and acquisition of nonwarfare skills. The Officer Master File, in combination with the Officer Attrition Tape, is also the source for behavioral data on attrition (cf. Bruce & Burch, in review).

The third and final source of data considered here consists of changes in organizational policies and/or sociocultural factors that influence career decisions and development (Morrison & Cook, 1985). A straightforward measurement of reactions to policy change is reflected in the 1986 questionnaire for URL(G)s in regard to detailing (see question 20, page 8). However, in general, policy changes and changes in the sociocultural environment that may influence career decisions are being tracked by the researchers (e.g., changes in the labor market). Such information may be employed to explain results of lagged forms of analyses, such as changes in measurement models (i.e., factor structures) in the 1982 wave versus the 1986 wave. Moreover, if changes are quantifiable and vary for different groups of respondents (e.g., a new policy had been implemented in some geographic locations but not in others at the time of 1986 wave measurement), then some form of quasi-experimental analysis with nonequivalent control groups may be implemented.

We shall not attempt to explicate all the variables contained in these various sources of data. A basic overview and brief description of variables is provided by Morrison and Cook (1985, pages 22-24), who also furnish overviews of the development of the Officer Quality Index (see Morrison et al., 1984 for a more detailed description of this study) and measures of career satisfaction. Examination of the questionnaires indicates the breadth of the domains of measurement. Recent reports by Bruce and Burch (in review) and Wilcove, Bruni, and Morrison (1987) illustrate not only modeling to address specific research questions with selected variables, but also the overall quality of the data. The report by Morrison (1983) on interviews with SWOs and the series of reports on studies of Surface Warfare Junior Office Retention furnish valuable background information.

MODELS

Theoretical Models of Career Development

Theoretical models of career development in the Navy operate at two levels of specificity. The less specific, more global level of explanation is presented by Morrison and Cook (1985). Based on "a comprehensive review of career stage, decision making, and developmental theories" (p. v), Morrison and Cook proposed a general model for career development. Salient propositions and concerns included in this general model are as follows:

1. Career perceptions, decisions, and behavior are a function of interactions between individual characteristics (e.g., needs, values, abilities), organizational factors (e.g., structure, policies, requirements, communication processes), social factors (e.g., family support, social influences from peers), and both actual and perceived influences engendered by sociocultural environmental factors, including changes in these factors (e.g., economy, labor market, political environment). These propositions are reflective of

an overall person-environment fit model (Endler & Magnusson, 1976; Pervin, 1968; Van Harrison, 1978).

2. Causal models linking the factors above the career perceptions, decisions, and behaviors are dynamic, which is to say subject to change over time. Change may be reflected in many ways, two examples being changes in Navy policy, which function as main effects for career variables as well as moderators of causal relations between career variables and other causal factors, and changes in the values and attitudes of different cohorts in the research samples (e.g., generational differences), which may also function as both main effects and moderators. As noted by Morrison and Cook (1985), to be successful, "organizations should anticipate and adapt to changing values, attitudes, and priorities of current and potential employees" (p. 1).

3. Adherence to, versus deviation from, structured career paths receives major consideration in this model. Operationalized in terms of the research, issues of importance pertain to whether individuals remain in unrestricted line positions exclusively, remain in unrestricted line positions but achieve skills in a subspeciality through training courses or formal graduate education, or transfer to a new occupational speciality in the restricted line or staff.

4. The career paths for individuals are themselves dynamic. The logic here is based on life-span development theory, which suggest that career decisions involve a series of major and minor choices over time. While it is expected that prior choices and decisions will influence later choices and decisions, it is also possible, indeed likely, that the causal factors of salience in early career decisions are different from the causal factors of salience in middle and late career decisions. In other words, causal factors for career decisions are sequentially moderated by time, which reflects variation in factors such as age, maturation, and changing value systems (James, Joe, & Irons, 1982; James & Tetrick, 1984). It is also noteworthy that characterizing career growth/development/maturation in terms of a dynamic, sequential moderation model ties directly into the current controversy on cross-situational consistency versus cross-situational specificity of behavior (cf. Epstein, 1979, 1980, 1983; Epstein & O'Brien, 1985; James & Deviney, 1988; Mischel & Peake, 1982; Pervin, 1985). In effect, the Morrison and Cook model takes the form that is known as "coherence" model, which states that while behavior is cross-situationally specific in a relative sense (cf. Endler & Magnusson, 1976), the dynamic profiles of specific groups of individuals, reflecting behaviors over time and in different environments, are predictable. This is a rather different model than the "trait" or cross-situational consistency model prevalent in selection and classification research, and represents a major step forward in personnel research.

5. Yet another aspect of the proposed dynamic model is the cyclical nature of relations among the causal factors. An example of a cyclic model is the now classic psychological success paradigm presented by Hall (1971) and reported in Figure 3 by Morrison and Cook (1985). Key predictions that evolve from this model are (a) persons and situations reciprocally interact with one another (cf. Endler & Magnusson, 1976) and thus the person-environment fit model should be extended to include the effects of individuals on situations (e.g., the types of individuals who self-select and/or are formally selected for a particular environment influence the characteristics of that environment), and (b) perceptions of self-efficacy (e.g., self-confidence, self-esteem), affect (e.g., job satisfaction), motivation, and behavior both engender and are engendered by salient perceptual factors (e.g., challenge, support, autonomy), and thus changes in any factor (e.g., challenge) may permeate the entire (open) system over time.

While not exhaustive, these appear to be among the main facets of the Morrison and Cook general model of career development and decision making. From this general model are derived a number of research hypotheses, which brings us to the second level of specificity. Morrison and Cook (1985) present a number of examples of research hypotheses (pp. 6-10) as well as methodological concerns that should be considered in attempts to test research hypotheses (pp. 12-17). Moreover, as reviewed earlier, the Bruce and Burch (in review) and Wilcove et al. (1987) reports demonstrate initial attempts to test specific research hypotheses that evolved from the general model.

Based on discussions with members of the PDCD work unit, two specific models are of prime interest at this time. The first model will be designed to explain the reasons why officers stay in the Navy versus leave, and is referred to as the "retention model." The second model will attempt to explain why officers stay operational (i.e., remain in unrestricted line positions) versus (1) remain operational but obtain a subspeciality or (2) transfer to a specialized occupation in restricted line or staff (i.e., change designators). From an analytic standpoint, the two (sets of) models are similar and thus, for illustrative purposes, we consider only the retention model in this report.

It is unlikely that a single retention model will suffice to explain all retention decisions. Rather, it is probable that a set of retention models will need to be developed and tested empirically. The need for a set of retention models derives from the likelihood that a series of boundary conditions exist in the overall data set, which is to say that a series of moderators exist that bound or limit the generalizability of a particular model to only a subset of the overall sample. In other words, different models will need to be developed for different subgroups of officers.

Two examples of potential moderators are career stage and community. To illustrate the role played by the first moderator, suppose analyses are conducted separately for communities, with SWOs as an initial choice. The general model advanced by Morrison and Cook (1985) predicts that the causal models for retention in the SWO community are sequentially moderated by career stage. Morrison (1983) suggests further that career choice points "appear to revolve around assignment decisions" (p. A-2), and thus one might use career choice points as the basis for grouping cohorts into sequentially moderated subgroups (not all cohorts may be included in this analysis). For example, based on Morrison (1983), the following four SWO subgroups might be developed: (1) officers who have been in the Navy for 18 to 30 months, (2) officers who have just completed a department head tour, (3) officers who have recently been screened for executive officer, and (4) officers who have recently been screened for commanding officer. These four subgroups form "social cohorts" (Morrison & Cook, 1985, p. 15) in the sense that members of each social cohort have recently shared a life experience (although the results of the experience are not the same for all members of a cohort), the experience is structured, the experience has a common generational framework that distinguishes one generation from another, and the experience is likely to have long-term effects.

A model of retention may be developed for each of the four sequentially moderated subgroups or social cohorts. An illustrative model tested by Bruce and Burch (in review) for Navy aviators is shown in Figure 2. This is a linkage, sequencing, or mediation variable model (James & Brett, 1984), or in statistical terms, a recursive model with

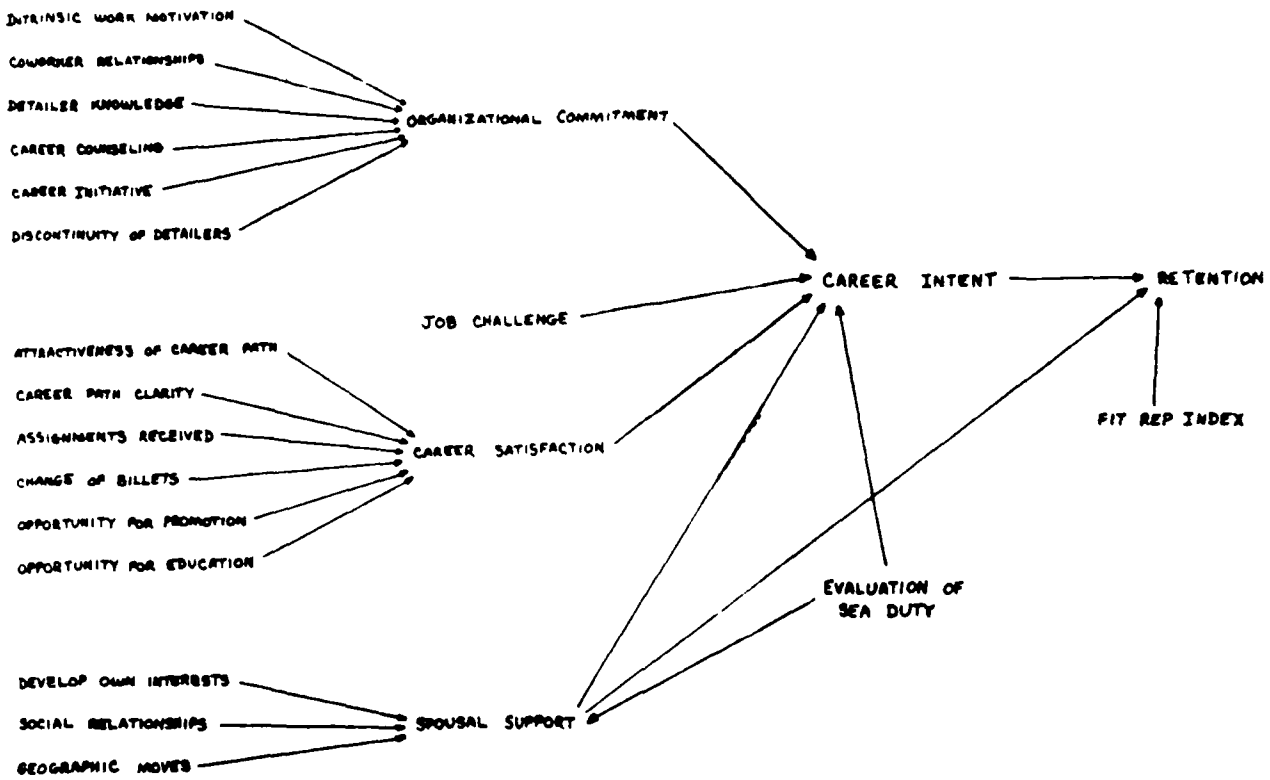
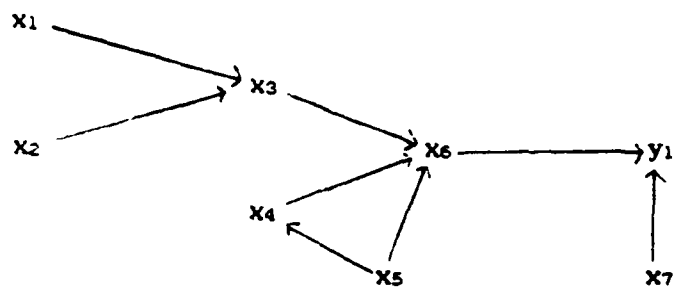


Figure 2. Retention model for naval aviators.

longitudinal retention data (the remainder of the model is cross-sectional). For illustrative purposes, we shall represent the model as:



where the x's refer to cross-sectional data (from questionnaires and the Officer Master File) and Y_1 refers to longitudinal retention data. Also for illustrative purposes, we shall assume that the x's and y's are the same for all social cohorts, realizing that this may not be the case in the final explanatory models developed for a specific cohort. The same variable sets allow for more direct tests of the statistical similarity of the models over cohorts, which are based on homogeneity of regression tests (cf. Johnston, 1984).

A set of potential analytic models is represented in Figures 3 through 5. Figure 3 presents eight replications of the model; one replication for each of four cohorts in each of two waves of measurement (y is again measured longitudinally in each replication). Within each wave of measurement, the four models representing different cohorts may be contrasted simultaneously by estimating the structural coefficients for each model separately, and then using linear contrasts to ascertain if the structural coefficients for the four models are the same or different (James & James, 1988; Johnston, 1984). More specific contrasts may be made between one or more subsets of models and theoretically viable a priori hypotheses may be tested using a form of planned comparisons (James & James, 1988). An alternative and quicker method of analysis is to employ LISREL to conduct the above homogeneity of regression analyses. In the LISREL analyses, all parameters for the four cohort models would be estimated simultaneously (under an equality constraint) and then a form of homogeneity test conducted.

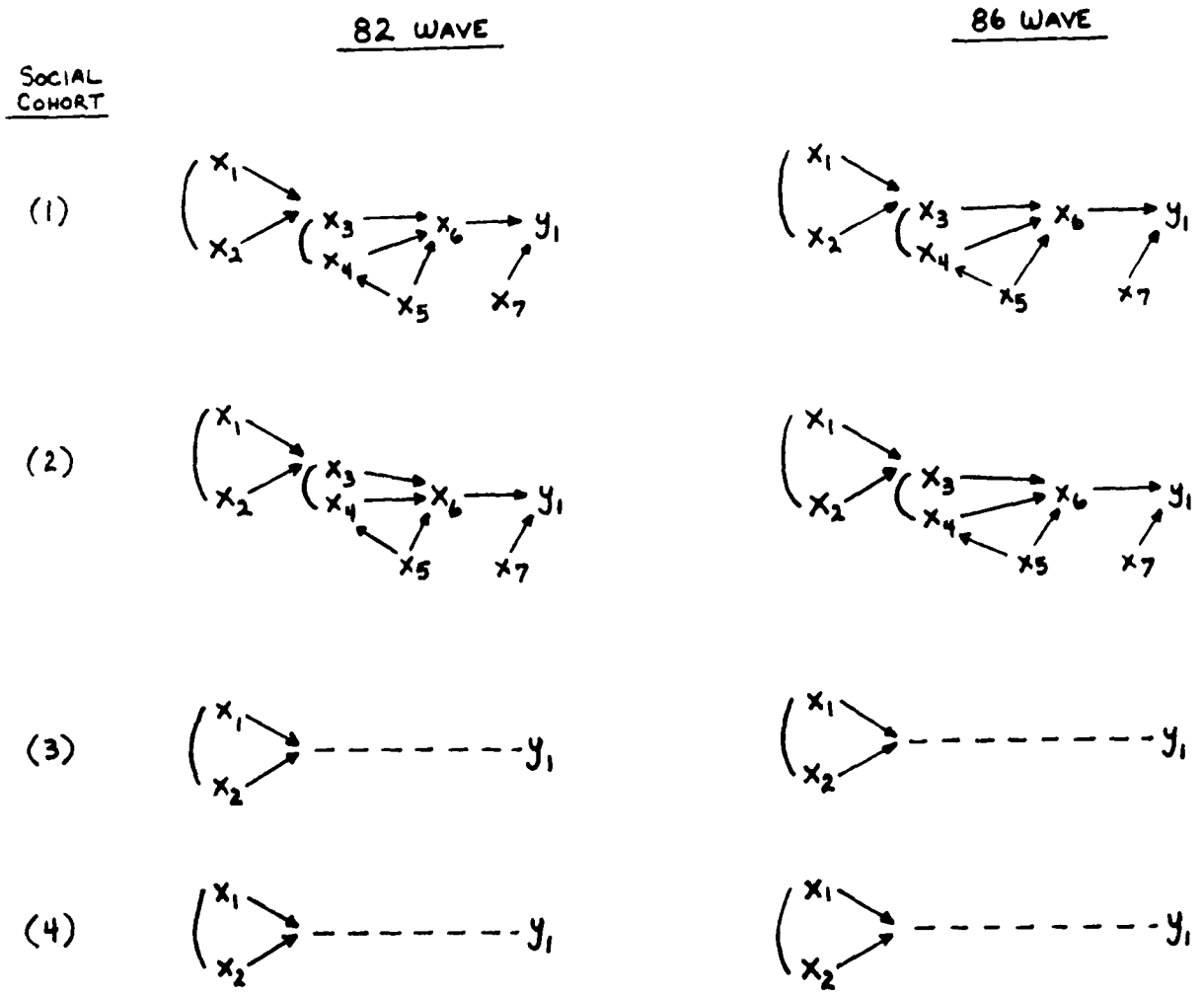
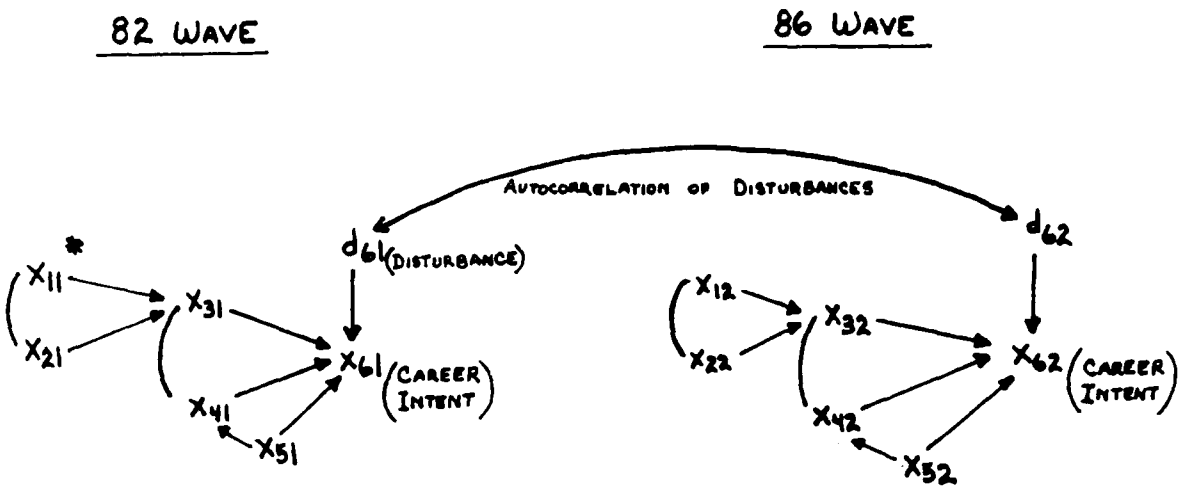


Figure 3. Retention models x social cohort x wave measurement.



*The first subscript refers to variable and the second subscript refers to time of measurement were 1 = 1982 and 2 = 1986.

Figure 4. Nonlagged time series for repeated measures data with a social cohort.

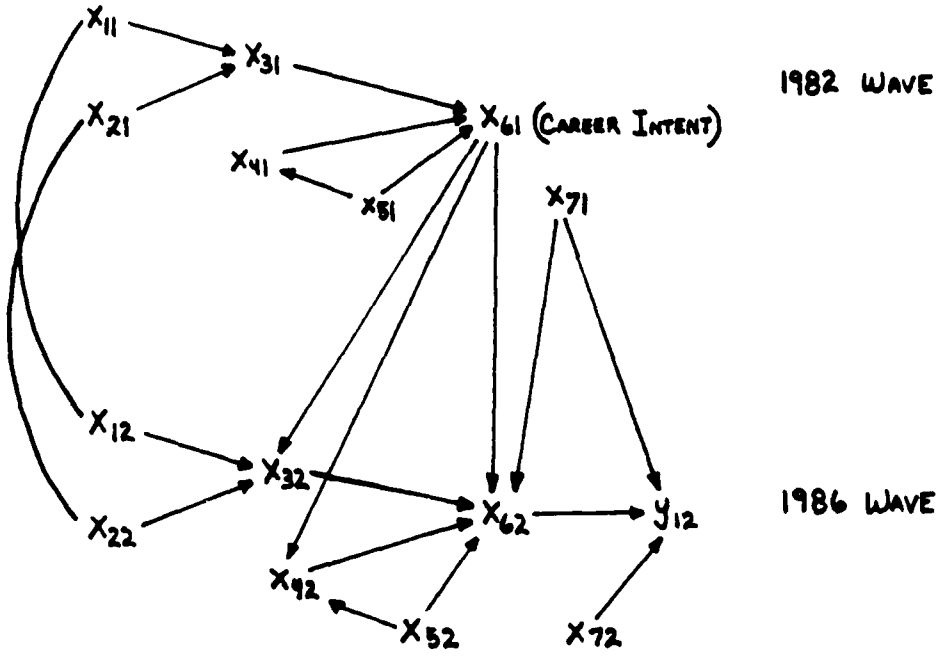


Figure 5. Lagged endogenous variable time series within a social cohort.

The analysis within each wave of measurement provides information as to whether causal models for retention vary by career stage. There are, however, many confounds in the data (cf. Morrison & Cook, 1985, pp. 12-17). In large part, the confounds relate to the fact that sequential moderation, with career stage as the moderator, refers to a cross-sectional time-series design (i.e., a form of repeated measures) where the same individuals are followed over career stages. The analyses described above reflect an independent groups design rather than a repeated measures design, where differences among diverse groups of different individuals (at different career stages) are used to infer what would happen to the same individuals over career stages (cf. James & Singh, 1978). The problem, of course, is that results based on independent groups in a cross-sectional design may not be perfectly congruent with results based on following the same individuals over career stages. This problem is solved by transferring to a time-series format of analysis. First, we consider another form of analysis based on Figure 3.

This analysis is predicated on the possibility that results of the cross-sectional, independent groups analyses described above are different for the two waves of measurement. Variation of results as a function of wave of measurement are suggestive of (1) changes in Navy policy or environmental factors during the period intervening between 1982 and 1986 or (2) the causal models for the same decision (e.g., whether to remain in the Navy beyond the Minimum Service Requirement) but for different cohorts (e.g., officers in the 18 to 30 month stage in the 1982 wave versus officers in the 18 to 30 month stage in the 1986 wave) are themselves different (i.e., a "longitudinally" defined cohort difference). Explanations "1" and "2" may both be operative as well, which indicates the need for documentation of changes in Navy policy and the sociocultural environment and, if possible, quasi-experiental analyses to investigate the effects of such changes on the data.

In the present context, homogeneity of regression analyses are indicated wherein models for the 1982 wave are contrasted with models for the 1986 wave. Such analyses are not a form of time series because different groups of individuals are being contrasted (i.e., longitudinal cohorts). Analyses may be conducted for one or more particular career stages (e.g., the 1982 model vs. the 1986 model for the two 18 to 30 month cohorts), subsets of career stages, or all career stages simultaneously. Analytic methods would be the same as described above.

We now proceed to time-series forms of analyses, which technically are referred to as cross-sectional time series inasmuch as measurements are taken on multiple (but the same) individuals at two or more points in time (cf. Nerlove, 1971; Hannan & Young, 1977; Johnston, 1984). (Time series usually refers to single subject designs.) The first form of time-series designed is a nonlagged model, as shown in Figure 4. The defining characteristics of a nonlagged time series are (1) all causal effects take place with a time interval (e.g., the time interval encompassed by the 1982 wave of measurement) and (2) there are NO lagged effects from one time interval to the next time interval (e.g., Career Intent in 1982 has no effect on Career Intent in 1986).

Figure 4 presents a nonlagged time series for explaining Career Intent for a selected social cohort. Since the same officers are involved in the two time intervals (i.e., repeated measures), the measurements on variables subject to change (e.g., Career Intent, organizational commitment) reflect perceptions, attitudes, and values for different career stages. According to the general model of Morrison and Cook (1985), we would expect the structural parameters in the two models to vary. That is, comparison of the 1982 model

with the 1986 model via homogeneity of regression tests that take correlated errors and structural coefficients into account (James & Tetrick, 1984) would be expected to indicate moderation by time (career state). Such moderation is interpreted to mean that the models are nonstationary.

It is noteworthy that if lack of moderation, or stationarity, were indicated, then new methods being developed by James and colleagues could be employed to correct for unmeasured variables problems. Unmeasured variables problems (or lack of self-containment) are the key problem with the use of confirmatory analytic designs on field data (James, 1980; James, Mulaik, & Brett, 1982). The techniques being developed by James and colleagues use an estimate of the autocorrelation between disturbances (see Figure 4) and generalized least squares to effect a statistical correction for this problem. We will address this issue further in our second report, but for now note that this process is likely nonapplicable in the context of the hypotheses generated by the Morrison and Cook model.

The final illustrative model presented in this report is a lagged time series (see Figure 5). Technically, this is not a true time-series model because a third wave of repeated measures is needed to test for stationarity. Nevertheless, the design takes the form of a lagged time series wherein variables measured at one point in time (1982) are viewed as causes of variables measured at a different point in time (1986). The model is a form of lagged endogenous variable time series (James & Singh, 1978) because a key endogenous variable--Career Intent--is viewed as a cause of itself (i.e., the causal arrow from X_{61} to X_{62}).

Like Figure 4, Figure 5 involves repeated measures on a single cohort, only here the objective is not so much to compare two sets of structure coefficients as it is to estimate structural coefficients for the 1986 measure of Career Intent (X_{62}) and the longitudinally measured retention variable (Y_{12}). Many arrows could be added or removed from this illustrative model--these decisions depend on theory and the cohort being analyzed. The important issue here is that this "quasi-lagged" form of time series corresponds more closely to the hypotheses advanced by Morrison and Cook (1985) than the nonlagged model in Figure 4. However, without a third wave of data, the techniques being developed by James et al. (1982) cannot be used to effect statistical controls for unmeasured variables. Consequently, it will be important to apply the decision rules advocated by James (1980) to decide whether analyses should focus on prediction without causal inferences versus causal analysis. Numerous analytic techniques are available, including basic cross-sectional time series, generalized least squares, and LISREL. We will address this issue specifically in our second report.

SPECIFIC ANALYTIC AND STATISTICAL CONCERNS

This report is concluded with brief overviews of specific analytic and statistical issues. Please note that our second report is to be devoted to analyses and statistics, where we will consider a broader selection of models, including quasi-experimental models, assumptions for analyses, and specific analytic techniques. At this time we consider statistical issues that, while receiving greater attention in the second report, the investigators may wish to consider in preparing for analyses.

1. Confirmatory analytic methods (path analysis, structural equation analysis, LISREL) designed to estimate causal parameters will be used frequently. While these analyses will be guided by the general career development model and models specific to

selected endogenous variables, it is likely that initial causal models will be disconfirmed. Hence, like the Bruce and Burch (in review) analysis, it will be necessary to conduct "exploratory" forms of analysis to build data-based causal models. Exploratory forms of analysis designed to develop causal models with good statistical fits to data are referred to as "specification analyses" (cf. MacCallum, 1986). Models developed by specification analyses need to be tested with new data--a form of cross-validation (Cudeck & Browne, 1983). Hence, we recommend the use of cross-validation or hold-out samples whenever possible.

2. The investigators have a choice of using latent variable versus manifest variable designs in the confirmatory analyses, or perhaps some mixture of the two (cf. James et al., 1982). When possible, we recommend the use of latent variable designs. In part, this recommendation is based on the points in favor of latent variable designs reviewed in James et al. (1982--e.g., use of perfectly reliable variables in structural portions of models). This recommendation is also based on issues of special importance to this particular data set, such as the following:

a. A number of item composites or scales now being used as manifest variables are based on only a few items, with accompanying modest (although often acceptable) coefficient alphas. This is likely to raise a red flag in future scientific reviews and journal reviews of reports and manuscripts. Where possible, we suggest that subsets of the present manifest scales be treated as indicators of higher-order, more explanatory latent variables, which in turn could be used in the structural portions of confirmatory analyses. Note that the latent variables could be developed in part by exploratory analysis (inspection of correlations of manifest scales, higher-order exploratory factor analysis) if the cross-validation effort recommended in "1" above is adopted (Schmitt, 1987). (One would then be cross-validating measurement models as well as structural models.)

b. The repeated measures portions of lagged designs (e.g., Figure 5) involve readministration of the same questionnaire items and scales. The likelihood exists that measurement errors for manifest indicator variables (i.e., the scales or item composites) will be autocorrelated over time. Within the constraints of identification, correlated measurement errors may be included, and tested, in the measurement sections of latent variable models.

c. The use of a comparatively large number of manifest causal variables in confirmatory analyses increases the probability of multicollinearity (cf. Gordon, 1968). An associated problem encountered in latent forms of analysis is "empirical under identification," which often occurs when two or more first-order factors are highly correlated and hence are possibly indicators of the same underlying latent construct (Dillon, Kumar, & Mulani, 1987). A potential solution to both problems is to identify higher-order latent variables into which highly correlated manifest variables/first-order factors can be clustered.

d. Morrison and Cook (1985) note the need to compare factor structures for different cohorts as well as for repeated measurements on the same cohorts. Tests of the measurement portions of latent variable models via LISREL address this analytic need directly. Moreover, additional measurement models for nonlagged data (i.e., data from officers who participated in only the 1982 wave or the 1986 wave) may be developed and contrasted with measurement models for repeated measures data. Such contrasts allow for partial tests of reactivity resulting from completing questionnaires on multiple occasions.

3. It is suggested that calculation and use of change scores (of any form) be avoided (Cronbach & Furby, 1970). In place of change score analysis in quasi-experimental designs, we shall recommend the use of hierarchical regression techniques (which are more flexible than covariance designs, see Cohen & Cohen, 1983).

4. How to cluster cohorts is a primary question raised by Morrison and Cook (1985). Any attempt to cluster the present cohorts defined by year of commissioning will require tests to ascertain whether descriptive data are similar versus different (e.g., distributional data such as means and standard deviations), whether psychometric data are similar versus different (e.g., reliabilities, measurement models), and whether structural coefficients are similar versus different (i.e., homogeneity of regression tests). We suggest that knowledge of Navy practices and policy combined with predictions generated by the career development model or models specific to endogenous variables, such as retention, be employed to define clusterings of cohorts. An example is the clustering by similarity of career stage and decision points illustrated in Figure 3. Such clusters have a substantive base and may be checked empirically. A less desirable method is to cluster simply on the basis of empirical similarity using profile analytic techniques. A key problem with these techniques is that 25 percent or more of the sample usually fail to fit unambiguously into a cluster, which stimulates generalizability problems.

5. Moderator or homogeneity of regression tests represent a central theme throughout the analyses. It is generally recommended that such tests, as well as any form of time series analysis, be predicated on nonstandardized data (cf. James et al., 1982). This raises the problem that some item scales were changed in the 1986 wave questionnaires in relation to the 1982 wave questionnaires. We recommend that an attempt be made to rescale the "longer" item scales to make them comparable to the "shorter" item scales and thereby preserve a form "raw scores." Rescaling should be predicated comparisons of distributions and correlations, and employ both lagged as well as nonlagged data (the latter data allow for checks on reactivity such as carry-over effects and both beta and gamma change--see Golembiewski, Billingsley, & Yeager, 1976).

6. The availability of both lagged and nonlagged questionnaire data introduces the interesting question of whether to attempt to maximize sample sizes in cross-sectional studies by including officers who completed questionnaires in both waves of measurement and officers who completed questionnaires in only one wave (e.g., a cross-sectional study on the 1982 wave data that includes both officers with 1986 wave data and officers with only 1982 wave data). While such an approach maximizes power and generalizability, it limits attempts to pursue additional analyses involving lagged and repeated measures data on a comparable sample. When both cross-sectional and lagged analyses are to be conducted, we suggest that the cross-sectional analyses be conducted on two samples, namely (a) officers who have both lagged and nonlagged data, and (b) officers who have only lagged data. Hopefully, results of cross-sectional analyses will be similar for these two samples. If this is not the case, then the investigators will know where the statistical differences occur and may take these differences into consideration when interpreting results of later lagged analyses.

7. A similar recommendation applies to studies on "selected samples." An example of a selected sample analysis is the Bruce and Burch (in review) study, where equal sample sizes of (married) stayers and leavers were selected. Equal sample sizes for stayers and leavers is a solution to the base-rate problem, especially given a dichotomous criterion and the use of point-biserial correlation (cf. Lord & Novick, 1968). However, a problem arises when one wishes to judge the effectiveness of the equations in explaining/predicting

retention in an unselected population wherein the stayers and leavers are not equally represented (i.e., the base rate is not 50%). Our opinion is that the use of equal sample sizes is a reasonable means for developing a statistical explanatory/prediction system. However, the effectiveness of this system should be checked by application of this system to a general, unselected sample in the same sense that initial validation systems are cross-validated.

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